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ABSTRACT

This study focuses on student response to computer-assisted instruction (CAI) after it was introduced into a college level physical geography course, "Introduction to Weather and Climate." PLATO, a University of Illinois mainframe network developed in the 1960s, was selected for its user friendliness, its large supply of courseware, its online record keeping ability, its graphic display capabilities, and the wide acceptance and distribution of the system. At the end of the semester a questionnaire was distributed to the students to determine their response to CAI. The bulk of the questionnaire dealt with the students' overall acceptance of the PLATO system and the identification of potential areas of difficulty associated with CAI adoption. The relationship between computer use and student performance was examined by calculating the Pearson Product-Moment Correlation Coefficients between two use variables: (1) the total amount of time students spent using PLATO and the total number of lessons they attempted; and (2) class performances as derived from classroom administered instruments such as quizzes, laboratory assignments, and examinations. The findings revealed a strong positive relationship between the total number of classroom quizzes taken and both total hours on PLATO and PLATO lessons completed, but a relatively weak relationship between these variables and laboratory exercise completion rate. The appendix contains a copy of the student questionnaire, and a 51-item bibliography is included. (DJC)

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PLATO Based Computer Assisted Instruction:

An Exploration

by

R. Wise

Presented at NCGE Annual Meeting

Springfield, Missouri

October 20, 1987

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Introduction and Methodology

This paper reports upon an attempt to introduce computer assisted instruction, hearafter abbreviated as C.A.I., into a college level Physical Geography course, Introduction to Weather and Climate. My remarks here will deal primarily with the response of students to the introduction of computer assisted instruction. However, I should note that the research framework underling this paper consisted of a comprehensive review of the rationale and justification for the use of Computer Assisted Instruction as well as an investigation of the problems associated with computer system and softwear selection.

The results of this study are exploratory in the sense that the research was designed and executed to find out what kinds of things would happen when computer assisted instruction was introduced into an ongoing course. Thus it was anticipated that the primary results of this inquiry would not be definitive statements regarding educational strategies but rather, at best, tentative hypotheses.

Course Content and Student Characteristics

The Introduction to Weather and Climate course offered at Eastern Illinois University is typical of most introductory, general studies based science courses. The course functions as an introduction to Physical Geography for entry level majors as well as a course which will satisfy the laboratory science component of a 9 hour math-science requirement in the university's general studies curriculum. The content and structure of the Introduction to Weather and Climate course is not very different from that of similar courses offered at other universities, (Scott, 1984; Bacon and Green, 1983; De Souza and Ross, 1983; Eaglemen, 1980).

The course consists of the primary atmospheric science topics outlined in Table 1.

Table 1

Topical Content and Time Allocations
in the Introduction to Weather and Climate Course

Topic	Time Devoted to Topic
Introduction to The Earth Sciences	1-2 days
The Structure and Composition of the Atmosphere.	1 week
Solar and Terrestrial Radiation.	2 weeks
Temperature	1-2 weeks
Pressure and Winds	2 weeks
Moisture and Precipitation	2-3 weeks
Weather Forecasting and Severe Weather	3 weeks
Urban Climates	1 Week
World Regional Climatology	1-2 weeks

Student Characteristics

The introductory Weather and Climate course has been a relatively 'effective' course in terms of its ability to attract students as evidenced by the fact that all sections are typically filled on the first day of class registration. Paradoxically this 'attractiveness' is a major source of difficulty in the organization and teaching of the course as it tends to produce a class characterized by great extremes in both ability and motivation. Typically the students in any particular section of the course range from first semester freshmen to graduating seniors. This diversity in academic background is compounded by an equivalent variability in preparation in science and mathematics.

Potential Benefits of C.A.I.

After struggling with the problems outlined above for some time I decided to experiment by introducing C.A.I.into the Introduction to Weather and Climate course. Some of the potential benefits associated with C.A.I. implimentation which have been cited in the literature are outlined in Table 2.

Table 2

Potential Class Related Benefits of C.A.I.

(1) Increasing student achievement, (Kulik, Kulik,and Cohen, 1980; Kane and Sherwood, 1980; Wooley,1978)

(2) Improving attitudes toward the course and computer use, (Kulik, Kulik, and Cohen, 1980; Battista and Krockover, 1984; MacQueen, Brown and Cutlip, 1983; Cavin, Cavin and Lagowski, 1981).

(3) Increased time savings for both the faculty and students, (Kulik, Kulik, and Cohen, 1980),

(4) Allowing students to exert greater control over both their allocation of time and selection of instructional materials. (MacQueen, Brown and Cutlip, 1983; Montanelli, 1979).

Computer System and Software Selection

Once the decision had been made to incorporate C.A.I. activities into the Weather and Climate course the next step in the implementation process was the selection of a computer delivery system and associated software. Unfortunately, this selection process does not appear to have been effectively modeled in the literature. The criteria for system selection have been outlined, (Hofstetter, 1985), and numerous articles describing both computer and software selection have appeared in the literature. (Jay, 1983; Goals, 1983; Steinberg, 1983; Gagne, Wagner, and Rojas, 1981). What doesn't seem to exist is a comprehensive discussion of the structural relations between system characteristics and selection criteria, (Hofstetter, 1985), (Jay, 1983), and instructor's objectives, (van Dijk, et. al. 1985),.

After considerable experimentation the PLATO system was selected as the computer delivery system for use in this study. This computer system is an integrated mainframe network developed at the Univesity of Illinois in the 1960's. Since its initial development the PLATO system has expanded to become both a national and international network, however, the host computer at the University of Illinois still functions as a regional node serving community colleges, and universities within the state.

A primary factor in this selection was the fact that the PLATO system was an integrated, already functioning, C.A.I. delivery system whose duplication would have required immense investments in time and resources. The specific characteristics that were identified as being most important in the selection process were are listed in Table 3.

Table 3

PLATO Selection Criteria

(1) PLATO's superiority in user friendliness.

(2) The obvious advantages of the PLATO graphics display device over the line printer graphics of other mainframe systems.

(3) The large supply of already developed courseware on the PLATO system.

(4) The online record keeping capabilities of the PLATO system which would have had to be created on the other computer systems.

(5) The relative accessibility of the PLATO terminals in the university library.

(6) The wide acceptance and distribution of the PLATO system which has resulted in an extensive, system specific, research literature dealing with C.A.I. at the college and university level.

Student Response to PLATO Adoption

In the final analysis the decision to use computers in the classroom will depend upon student response to the innovation. The following analysis of student response to Computer Assisted Instruction is based upon a semester long evaluation of one 35 student section of the Introduction to Weather and Climate class. I will restrict my remarks to a discussion of two outcomes, student achievement and affective response. I will discuss student achievement first.

The tentative nature of this analysis is a reflection of limitations imposed by both study formulation and the data collection process. The PLATO use data available consisted of system generated summary statistics, (Table 4,) such as the total number of lessons completed and total hours and days on the PLATO system. This information was supplemented by the inspection of individual student PLATO use records which provided a listing of which lessons had been attempted and completed and sign-on and sign-off times for each student.

Table 4

PLATO Generated Statistics

(1) The date and time of most recent student sign-on.

(2) Total student time on the system in hours and minutes.

(3) The total number of lessons attempted.

(4) The total number of student sessions on the system. (Each sign-on is a session even if the student inadvertently signed off while completing one lesson and beginning another)

(5) The total number of days each student is on the system. (Each day the student signs on is recorded as a discrete event, no matter how many times a student may sign-on in a given day)

The information dealing with student achievement was derived from classroom administered instruments such as quizzes, laboratory assignments and examinations. In many instances these instruments were not designed in ways which explicitly isolated achievement which could be directly related to PLATO based activities. As a consequence the relationships between PLATO use and student achievement discussed here are best treated as preliminary hypothesis.

Research dealing with the relationship between C.A.I. adoption and student performance, suggests a relatively consistent, slightly positive increase in student performance in response to the use of C.A.I. in controlled, experimental, classroom settings, (Kulik, Kulik and Cohen, 1980).

In this study the relationship between computer use and student performance was initially examined by calculating the Pearson Product-Moment Correlation Coefficients between two use variables, i.e.,the total amount of time students spent using the PLATO system, and the total number of lessons they attempted, and class performance, as indicated by final course grade, (see Table 5) The use of the final course grade as a surrogate for learning is an obvious weakness in the study.

Table 5

Pearson Product-Moment Correlation Coefficients and p Values[1] for Salient PLATO Use and Class Performance Variables[2]

Variable	N	$\bar{X}$	S.D.	Correlation Coefficients				
				Total Hours	Total Lessons	Total Quizzes	Total Labs.	Final Grade
Total Hours on Plato	132	4.90	4.21	1.00				
Total Lessons Attempted	132	6.46	4.21	.714	1.00			
				.001				
Total Quizzes Taken	132	6.80	2.33	.486	.487	1.00		
				.004	.005			
Total Labs. Completed	132	4.90	1.90	.141	.145	.530	1.00	
				.442	.428	.002		
Final Course Grade	132	3.14	.80	.284	.509	.464	.469	1.00
				.115	.003	.007	.006	

[1] The top number in each cell in the matrix is the correlation coefficient the bottom number the p value. The p values indicate the probability of obtaining a correlation coefficient as large as that recorded from a sample of size N if the correlation between the variables were 0.

The identification of positive correlations between global measures of PLATO use and student performance was not unexpected given previous research findings. The relative significance of these correlations was examined through the use of the t statistic with the alpha level set at .05. (Glass and Hopkins, 1979.pp 300-302; Harnish and Palmer, 1984. pp. 59-60.)

This analysis indicated that the correlation between the total number of PLATO lessons a student attempted and their final grade was statistically significant at the .05 level,(p=.003) i.e., there are only three chances in a thousand that the correlation coefficient between these two variables would be equal to zero. The R^2 value for these two variables indicates that approximately 25% of the variation in final course grade was associated with the number of PLATO lessons a student attempted. A similar analysis of the relationship between course grade and the total hours spent on the PLATO system did not produce a statistically significant p value,i.e., (p=.115).

The observed differences in significance in these two highly correlated PLATO use variables might be explained on the basis of sampling error, or by the fact that they are based upon different performance indicators. Thus one might argue that the amount of time a student spends on a particular PLATO lesson may be a function of several factors such as prior experience or overall work efficiency, and that these attributes are not as strongly related to achievement as were those factors which induced students to experiment with a number of different PLATO lessons. It is also possible that the student who attempted more lessons is more inquisitive and more willing to accept risk and that these characteristics are an integral part of course achievement and academic success.

These findings raise the question of the extent to which one can safely attribute cause and effect relationships to the use of PLATO and course achievement. Given the numerous cautions cited in the literature it seems just as reasonable to ask if the qualities of persistence and task attendance might not be as applicable in C.A.I. activities as they are in other activities such as class attendance, and the completion of course assignments. This possibility was investigated by calculating the Pearson Product- Moment Correlation Coefficients between the total number of laboratory exercises and classroom quizzes completed during the semester and the PLATO use variables discussed above. (See Table 5 above.)

These correlation coefficients and p values (Table 5) suggest a strong positive relation between the total number of classroom quizzes taken and both total hours on PLATO and PLATO lessons completed, but a relatively weak relationship between these variables and laboratory exercise completion rates. The difference between these coefficients may be explained, in part, by the fact that the quizzes are a surrogate for class attendance while the number of laboratory activities completed is not as strongly related to class participation since students often complete laboratory activities outside of normal classroom meeting times.

This limited support for the possibility that activities such as class attendance and participation, and overall commitment to class related activities, may be responsible for the positive relationship between PLATO use and student performance raises questions about the proper directional relationship between C.A.I. instruction and achievement. Is it possible that computer use tends to encourage student interest in class related activities, (Kulik, 1983; Brenenstuhl, 1975), thus strengthening class attendance and participation or is participation in C.A.I. activities primarily an extension of an existing behavior pattern? Similar research findings regarding a positive relationship between achievement and computer use by both Haritg, (1984) and Ross, (1984) suggest that the latter may well be the true state of affairs. Subsequent research with other Introductory Weather and Climate classes has revealed a high, positive correlation between cumulative grade point average and measures of PLATO use.

It is also possible that any improvement in achievement arising out of the use of C.A.I. might just as easily be attributed to the more specific task identification and focus, and associated increases in time on task growing out of computer use, as to any innate superiority for computer assisted instruction.

Student's Affective Response to PLATO Assisted Instruction

The second aspect of student response to PLATO assisted instruction investigated in this study was affective response. The literature dealing with the affective response of students to C.A.I. is somewhat limited in scope. A persistent theme in this literature is the suggestion that computer use may lead to improved attitudes toward computers as well as to improved attitudes toward both the course and the course content in which the student experiences C.A.I., (Kulik, Kulik and Cohen, 1980; Cavin, Cavin and Lagowski, 1981). More recent research cautions against a simplistic relational interpretation of changes in the affective domain in response to the use of computers in the classroom. (Battista and Krockover, 1984).

A second research focus has been the relationship between changes in the affective domain and the salient characteristics of the student population. Here the primary emphasis seems to be upon the question of the effect of either prior or current computer experience upon the the affective response of students, or upon the relationship between gender, and students affective response to computer use, with, at best, ambivalent results, (Wooley, 1978; Cavin, Cavin and Lagowski, 1981).

Data Collection

The exploratory format of this study precluded any attempt to identify course related changes in students attitudes towards computers, computer use, or course content. It was, however, possible to assess students overall satisfaction with particular aspects of PLATO use with the expectation that this information might be used as a guide for future research.

At the end of the semester a questionnaire was administered to the students enrolled in the class. The individual questions selected for use on the student response questionnaire may be grouped under four general headings. (See Table 6 below)

Table 6

Primary Affective Domain Characteristics

(1) An assessment of prior computer experience

(2) An assessment of student acceptance of PLATO and its applicability in The Introduction to Weather and Climate class.

(3) An assessment of student response to the personal-interactive aspects of PLATO use.

(4) An assessment of student response to system-lesson related considerations.

A copy of the affective response questionnaire which lists the percentage response of students to each item is included as an appendix.

Computer Background

Student response indicates that the majority of the students enrolled in the Introduction to Weather and Climate class had little prior experience with computers. Since it also appears that the class was generally receptive to C.A.I. delivered via the PLATO system , (note the responses to questions 3, and 19), the link between computer acceptance and prior computer use would appear to be rather tenuous.

I might add that my own 'hunch', is that much of the ambivalence reported in the literature regarding the relationship between computer use and affective response to C.A.I. may well be due to problems in the definition and measurement of what constitutes computer acceptance, use and experience. I would also suggest that research in this particular area might profitably focus upon the problem of computer avoidance, a term which I have coined to describe the behavior of that small segment, typically 1-5%, of each class, which refused to use the PLATO system.

Student's Response to a PLATO Based C.I.A. System

The bulk of the the questionnaire dealt with the student's overall acceptance of the PLATO system and the identification of potential areas of difficulty associated with C.A.I. adoption. In order to reduce halo effects the questions dealing with each general topic were randomly scattered throughout the questionnaire when it was typed. To facilitate discussion those questions dealing with a particular topic have been regrouped under a single heading.

In addition an 'average' response score was calculated for each question by weighting each student response by the numerical value assigned to that response. In general high scores indicated acceptance or support of a statement, low scores indicate disagreement.

Student Acceptance of PLATO

The following questions dealt with the topic of student acceptance of the PLATO system.

Table 7

Student Acceptance of PLATO

Statement Number		'Average' Score
(3)	I enjoyed using PLATO	3.80
(6)	I would encourage my friends to take a course using PLATO	3.14
(16)	I often worked on PLATO lessons that weren't required	3.12
(12)	I learn better in classes that use PLATO	3.05
(20)	Computers ought to be more important in our learning	2.60
(9)	Too much time was spent using PLATO in this course	2.45
(19)	Using PLATO is boring	2.35
(2)	PLATO is nothing but a baby-sitter for the teacher	2.00

Overall, students responded favorably to the PLATO system, (questions 3 and 19), and they seemed to feel that its use was germane to course activities, (questions 2 and 9). Student's perceptions of the relationship between PLATO use and class preference and performance were, at best, neutral, (questions 6 and 12).

The interpretation of the mean score for question 20 is most difficult. On the one hand the slightly negative response to the question seems to be at variance with the student's acceptance of the PLATO system, (questions 3, 9, and 2), suggesting a possible distinction between PLATO and computers in general. There is also some evidence that this question may have triggered an emotional response as several students took exception to the use of the word learning in question 20 by writing comments on the questionnaire indicating that they felt learning and computer use were distinctly separate activities.

Personal-Interactive Aspects of PLATO Use

The following questions dealt with the personal-interactive aspects of PLATO use.

Table 8

Personal-Interactive Aspects of PLATO Use

Statement Number		'Average' Score
(1)	I like PLATO because it lets you take part in each lesson	3.80
(5)	I felt comfortable working with PLATO	3.65
(11)	I like PLATO because you can make mistakes without everyone knowing it	3.60
(17)	PLATO allowed me to assume responsibility for my learning	3.55
(15)	PLATO made helpful comments on my work	2.95
(14)	PLATO seemed to know when I didn't understand	2.80
(7)	PLATO makes me feel as though I am not a person	1.74

As might be anticipated the personal-interactive aspects of C.A.I. received very favorable marks from the students. Most students were not apprehensive about working with the PLATO system, (questions 1 and 5), nor did they find the experience dehumanizing, (question 7).

Students response to questions 11 and 17 suggest that both the anonymity of computer based formative evaluation and the ability to exert some control over one's learning may well play an important part in the acceptance of computers in the classroom.

Questions 14 and 15 received the least favorable response in this category. Since these questions are borderline lesson-software related questions which seem to include some anthropogenic attributions of human behavior to the PLATO system, interpretations of student responses are questionable.

System-Lesson Related Considerations

The following questions dealt with the system related aspects of PLATO use.

Table 9

System Related Aspects of PLATO

Statement Number		'Average' Score
(8)	PLATO made good use of examples and illustrations	3.65
(10)	PLATO always seemed to be breaking down	3.35
(18)	The mechanics of the PLATO system hindered my learning	2.42
(4)	PLATO did not give clear explanations of the material	2.25
(13)	Most PLATO lessons were too hard for me	2.00
(9)	Too much time was spent using PLATO in this course	2.45

The PLATO system received very high marks in this area. Overall there were very few service interruptions and only occasional problems with the terminals and the keyboards. There were apparently no serious lesson related problems, (questions 4 and 8). This outcome might be attributed, in part, to the use of lesson handouts which alerted students to specific difficulties in a lesson. It also seems that the lesson selection process was successful, (question 13).

Student response to the use of C.A.I. was generally positive, with students viewing the activity as non-threatening and germane to course content and objectives. There was some indication that students were most responsive to those attributes of the PLATO system which stressed autonomy, self-control of the learning process, and anonymity during formative evaluation.

The PLATO system and its lessons did not appear to be an important source of frustration or complaints. I suspect this is a reflection of the relative maturity of the PLATO system as a C.A.I. delivery device .

The most ambivalent response to the adoption of C.A.I. occurred in the areas of preference for C.A.I. based courses and the contribution of computers to learning in general. These results are contrary to those reported by Dovark, (1978) and Montavelli, (1979), they do, however, seem to lend support to Pagliaro's suggestion that C.A.I. is an essentially neutral technology which should be viewed as one element in a well rounded curricular structure, (Pagliaro, 1983). On this basis the contribution of C.A.I. should be evaluated in the same way as that of any other component in the learning process, i.e., in terms of its intrinsic characteristics and contribution to the overall mix of educational experiences available in a particular setting.

APPENDIX

Percentage Response to Computer Use Questionnaire

The percentage of the class choosing each alternative is indicated in the spaces provided for student response. N varies between 19 and 21.)

Before taking this course I had used (check the appropriate space)

a. A micro-computer . .. _25_ yes _75_ no

b. A mainframe computer _20_ yes _80_ no

c. PLATO . . . . . _15_ yes _85_ no

d. Other computers . _30_ yes _70_ no

e. I can write and run a computer program _30_ yes _70_ no

Percentage Response to Affective Response Questionnaire

The percentage of the class choosing each alternative is indicated in the spaces provided for student response. N varies between 19 and 21.

	strongly disagree 1	2	3	4	strongly agree 5	Mean	S.D.
1. I like PLATO because it lets you take .... part in each lesson.	0	0	40	40	20	3.80	.77
2. PLATO is nothing but a baby-sitter ..... for the teacher.	40	30	20	10	0	2.00	1.03
3. I enjoyed using PLATO	0	5	20	65	10	3.80	.70
4. PLATO did not give clear explanations .... of the material.	30	35	15	20	0	2.25	1.25
5. I felt comfortable working with PLATO	0	15	25	40	20	3.65	.99
6. I would encourage my friends to take a ... course using PLATO.	9	18	36	23	14	3.14	1.17
7. PLATO makes me feel as though I am ..... not a person.	42	42	16	0	0	1.74	.73
8. PLATO made good use of examples and ..... illustrations.	5	15	10	50	20	3.65	1.14
9. Too much time was spent using PLATO ..... in this course	10	50	30	5	5	2.45	.94
10. PLATO always seemed to be breaking down ..	40	15	15	30	0	3.35	1.31
11. I like PLATO because you can make ..... mistakes without everyone knowing it.	10	5	30	25	30	3.60	1.27
12. I learn better in classes that use PLATO .	5	15	55	20	5	3.05	.89
13. Most PLATO lessons were too hard for me ..	45	25	20	5	5	2.00	1.05
14. PLATO seemed to know when I didn't ..... understand.	20	25	20	25	10	2.80	1.32
15. PLATO made helpful comments on my work ...	19	14	24	38	5	2.95	1.24
16. I often worked on PLATO lessons that ..... weren't required.	6	24	29	35	6	3.12	1.05
17. PLATO allowed me to assume responsibility . for my learning.	5	10	35	25	25	3.55	1.15
18. The mechanics of the PLATO system ..... hindered my learning.	24	38	19	10	10	2.43	1.25
19. Using PLATO is boring	25	45	5	20	5	2.35	1.23
20. Computers ought to be more important ..... in our learning.	15	45	15	15	10	2.60	1.23
	1	2	3	4	5		

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